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PRELIMINARY REPORT ON WATER SUPPLY AND POLLUTION
CONTROL ASPECTS OF THE CHARITON AND LITTLE
CHARITON RIVER BASINS

PUBLIC HEALTH SERVICE
KANSAS CITY, MISSOURI

APRIL 1962

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16. Abstracts The results of a preliminary water supply and pollution control study of the Chariton and Little Chariton River Basins, in south-central Iowa and north-central Missouri, are presented. Included are brief discussions of the economy of the study area, population, ground water resources, water uses, future water requirements, waste waters, and the need for streamflow regulation.			
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PRELIMINARY REPORT ON
WATER SUPPLY AND POLLUTION CONTROL ASPECTS
OF THE
CHARITON AND LITTLE CHARITON RIVER BASINS

Prepared for the
U. S. Army Engineers District, Kansas City
Corps of Engineers

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Region VI
Water Supply and Pollution Control
Kansas City, Missouri

APRIL 1962

I. Authority

In a letter dated September 11, 1961, the Kansas City District Office of the Corps of Engineers authorized the Public Health Service to conduct preliminary water supply and pollution control studies on the Chariton and Little Chariton River Basins.

II. Project Description

The Chariton River Basin is located in the South-central portion of Iowa and the north-central portion of Missouri. The Chariton River rises near Osceola, Iowa, flows south-easterly approximately 70 miles to the Iowa-Missouri State line, and below the State Line flows almost due south for about 95 miles to a point near Glasgow, Missouri, where it joins the Missouri River. Rathbun Reservoir will be located near Rathbun, Iowa, on the main stem of the Chariton River. The following storage allocations are authorized:

<u>Purpose</u>	<u>Acre-feet</u>
Flood Control	327,000
Conservation	134,000
Sedimentation	<u>22,000</u>
	483,000

The Little Chariton River Basin includes the East Fork and Middle Fork River which rise south of Kirksville, Missouri, flow mostly south, and join to form the Little Chariton River approximately ten miles north of Glasgow, Missouri. The Little Chariton River flows into the Missouri River near Glasgow. See Corps of Engineers, Chariton River Basin map.

III. Study Area

Most of the Chariton and Little Chariton River Basins lie within a nine-county area in Iowa and Missouri: Lucas, Wayne, and Appanoose Counties in south-central Iowa, and Putnam, Schuyler, Adair, Macon, Randolph, and Chariton Counties in north-central Missouri.

The area of these basins is 3,080 square miles of which 925 square miles are in Iowa and 2,155 square miles in Missouri. Approximately three-fourths of the area is in the Chariton River Basin.

IV. Economy

Agriculture and related services are the most important economic activities in the study area. In 1950, the service establishments employed 50 percent of the labor force, and agriculture employed 39 percent of the labor force. Seven percent were employed in the manufacturing category, while two percent were in mining. The remaining two percent were unemployed.

Although the number of farms and acres of cropland harvested decreased from 1954 to 1959, the dollar value of all farm products sold increased during the same period.

Table No. 1 shows the value of all farm products sold in 1954 and 1959 in the study area.

Table No. 1
Value of All Farm Products Sold
(Dollars)*

	<u>1954</u>	<u>1959</u>
<u>Iowa</u>		
Appanoose	5,966,488	7,464,056
Lucas	5,879,354	8,653,520
Wayne	8,161,636	9,501,340
<u>Missouri</u>		
Adair	5,729,676	7,393,550
Chariton	10,712,303	15,275,224
Macon	8,459,245	11,632,391
Putnam	4,306,168	5,389,818
Randolph	4,635,345	6,906,320
Schuyler	<u>3,128,328</u>	<u>4,171,520</u>
TOTAL	56,978,548	76,442,739

*Adjusted to the 1954 value of the dollar

The dollar value of minerals extracted in 1958 and 1959 is relatively small (slightly more than 3.5 million dollars in 1958 and about 4.6 million dollars in 1959). However, coal deposits are abundant and an increased demand for coal or coal products could bring an increase in the value of minerals extracted and the number of persons employed in mining.

Manufacturing consists of numerous small firms, chiefly food and kindred products, leather and leather goods, and electrical machinery. The food and kindred products industry seems the most likely to expand in the future based on the agriculture of the area and expanded markets.

The value added by manufacturers increased from 14.7 million dollars in 1954 to 18.9 million dollars in 1958 (adjusted to the 1954 value of the dollar). Manufacturing employment remained relatively stable during this period.

V. Population

The total population of the study area decreased from 181,421 in 1920 to 120,101 in 1960. In some areas, urban as well as rural population decreased. As a whole, however, the urban areas showed a slight increase.

The major population centers of the nine-county study area are Moberly and Kirksville in Missouri, and Centerville and Chariton in Iowa. Shown in Table No. 2 are population trends for the counties and major cities in the study area.

Table No. 2

	<u>Population</u> <u>(1920 - 1960)</u>				
	<u>1920</u>	<u>1930</u>	<u>1940</u>	<u>1950</u>	<u>1960</u>
<u>Iowa</u>					
Appanoose	30,535	24,835	24,245	19,683	16,015
(Centerville)	(8,486)	(8,147)	(8,413)	(7,625)	(6,629)
Lucas	15,686	15,114	14,571	12,069	10,923
(Chariton)	(5,175)	(5,365)	(5,754)	(5,320)	(5,042)
Wayne	15,378	13,787	13,308	11,737	9,800
<u>Missouri</u>					
Adair	21,404	19,436	20,246	19,689	20,105
(Kirksville)	(7,213)	(8,293)	(10,080)	(11,100)	(13,123)
Chariton	21,769	19,588	18,084	14,944	12,720
Macon	27,518	23,070	21,396	18,332	16,473
Putnam	13,115	11,503	11,327	9,166	6,999
Randolph	27,633	26,431	24,458	22,913	22,014
(Moberly)	(12,808)	(13,772)	(12,920)	(13,115)	(13,170)
Schuyler	<u>8,383</u>	<u>6,951</u>	<u>6,627</u>	<u>5,760</u>	<u>5,052</u>
TOTALS	181,420	160,715	154,262	134,298	120,101

expected same
The study area is expected to increase at the same rate as their respective States from 1960 to 2000 (Senate Select Committee Print No. 5). Assuming the study area will continue to grow at the same rate after 2000, it

will reach an estimated population of 340,000 in 2060. The urban sector of the study area should reach 300,000, while the rural segment should be 40,000 by 2060.

Table No. 3

Population Projection (Thousands)

1960 - 2060

	<u>1960</u>	<u>1970</u>	<u>1980</u>	<u>2000</u>	<u>2030</u>	<u>2060</u>
Appanoose	16.0	17.2	19.1	24.4	33.3	45.2
Lucas	10.9	11.8	13.0	16.8	22.8	31.0
Wayne	9.8	10.5	11.6	14.9	20.3	27.5
Adair	20.1	21.7	23.9	30.7	41.7	56.8
Chariton	12.7	13.7	15.2	19.4	26.5	36.0
Macon	<u>16.5</u>	<u>17.8</u> ✓	<u>19.6</u>	25.1	34.2	46.6
Putnam	7.0	7.5	8.3	10.6	14.5	19.7
Randolph	22.0	23.7	26.2	33.6	45.7	62.2
Schuyler	<u>5.1</u>	<u>5.7</u>	<u>6.3</u>	<u>8.1</u>	<u>11.0</u>	<u>15.0</u>
TOTAL	120.1	129.6	143.2	183.6	250.0	340.0

✓ 15.4 per 1970 census

VI. Hydrology

A. Stream Flows

Table No. 4

Historical Streamflows in Study Area

Station	Location	River Mile	Years of Record	Flow in cfs		
				Maximum	Minimum	Average
Chariton River near <u>Prairie Hill, Missouri</u>	Three miles north- east of Prairie Hill	19.6	31	25,600	4.6	1,039
Chariton River at <u>Novinger, Missouri</u>	Six-tenths mile east of Novinger	73.1	27	22,900	0.1	692
Chariton River near <u>Center- ville, Iowa</u>	Three miles east of Centerville	125.1	21	21,700	0.1	336
Chariton River near <u>Rathbun, Iowa</u>	Eight-tenths miles northeast of Rathbun	139.0	2	16,600	0.1	-
Honey Creek near <u>Russell, Iowa</u>	Five and one-half miles southeast of Russell	Honey Creek-0.7 Chariton River-176.5	7	4,100	0	4.66

B. Ground Water

In most of the area covered by this report, ground water resources are not adequate to meet the municipal water requirements. Shallow wells, except those located in valleys adjacent to streams, do not furnish sufficient quantities of water; deep wells produce water that is generally too highly mineralized to be satisfactory for municipal supplies. The Missouri

Division of Health reports that in the area covered by this report, most deep wells produce only small quantities of water--on the order of one or two gallons per minute. They also report that wells that are drilled to greater depths run into salty, highly mineralized water that is unfit for municipal use. Novinger, Keytesville, and Salisbury, Missouri are located in river valleys near streams and obtain their water from drilled wells. Typical analyses from these well supplies show dissolved iron in a range of 3 to 60 ppm as Fe. Because there is a lack of adequate ground water, most cities use surface water supplies. Of the cities in the study area having populations of 1000 or more, ten use impoundments for their water supplies and one, Salisbury, uses well water.

VII. Water Uses

The surface water resources of the Chariton and Little Chariton River Basins are used for municipal and industrial water supplies, livestock watering, game fishing and other recreational purposes, and for the removal and ultimate disposal of waste water.

The high mineral content of ground waters has encouraged the development of surface sources for public supplies.'

Table No. 5 shows water supplies and quantities of water used by municipalities having populations of one thousand or more.

Table No. 5
Municipal Water Supplies

City	1960 Population	Water Supply	Rated Plant Capacity MGD	Average Plant Output MGD	Gallons per Capita per day
<u>Iowa</u>					
Centerville	6,629	Impoundment	1.70	0.40	60
Chariton	5,042	Impoundment	-	0.45	89
Corydon	1,687	Impoundment	-	0.13	77
Seymour	1,111	Impoundment	0.29	0.06	54
<u>Missouri</u>					
Huntsville	1,526	Moberly	-	-	-
Kirksville	13,123	Impoundment	2.10	1.30	99
Marceline	2,872	Impoundment	1.40	0.35	122
Moberly	*13,170	Impoundment	2.30	1.02	69
Salisbury	1,787	Wells	0.41	0.12	73
Unionville	1,896	Impoundment	0.27	0.10	53
Macon	4,547 ✓	Impoundment	1.38	0.80	176
Total	53,390			4.73	89 (Average)

*Including Huntsville

Most of the municipal and industrial water in the study area is obtained from impoundments. These impoundments collect sediment and their capacities decrease. The increase in water demands and the loss in impoundment capacities will result in a need for additional water.

VIII. Future Water Requirements

The total projected water demand for municipal and industrial water use in the study area is 60.0 mgd in the year 2060. This figure includes both municipal and industrial water and is derived from the projected population

1/ 200 per 1970 Census

(300,000) times a per capita use factor of 200 gallons per day.

The pattern and scale of economic activity expected in the future shows no evidence of any heavy water using industries, therefore, the future water requirements can be projected on a per capita basis.

The factor of 200 gpcd includes all of the water uses in a municipality, such as residential, commercial, public, and those industrial users which can reasonably be reflected in a per capita use figure. The present water use in the area is 89 gpcd and is expected to increase to the Nation's projected average of 152 gpcd by 2000 (Senate Select Committee Print No. 7).

Based on these figures, the gpcd should increase to approximately 200 gpcd in 2060. To meet the municipal and industrial water requirements in 2060, it is estimated that thirteen cfs will be required from the Chariton River and seven cfs from the East Fork. No municipal and industrial water storage will be required in either Mussel Fork or Middle Fork.

IX. Waste Waters

Calculations were made to determine the minimum flows required in the Chariton River, Little Chariton River, Middle Fork River, East Fork River, and Mussel Fork. These calculations are based on projected requirements for the year 2060. The requirements are determined by (1) assuming secondary treatment of all municipal sewage, the effluents of which discharge into the above rivers, and (2) using Select Committee (Print No. 29) recommendations for low flow requirements in maintaining adequate water quality control.

A report by the Missouri Conservation Commission states that during a 1951 survey, there was strip mine pollution in the Little Chariton River

watershed. Seventy miles of the East Fork and seventy miles of the Middle Fork received this type of contamination. The report states that acid and other substances formed after cessation of operations have been flushed into these streams resulting in fish kills.

Some work has been done to reduce contamination from the strip mine areas. There is not sufficient information available to determine how much the streams would be benefited by having additional streamflows. Surveys of the strip mine areas should be made in order to determine what streamflows will be required for the purpose of water quality control.

There have been no reports of damaging effects from insecticides or other chemicals used in agriculture.

The following minimum flows required for water quality control by the year 2060 are based on the organic loading received from sewage treatment plants using adequate sewage treatment:

<u>River</u>	<u>cfs</u>
Chariton River	33
East Fork	7 ~~12~~
Middle Fork	3
Little Chariton River	Minimum flows from East Fork and Middle Fork will result in adequate flows in the Little Chariton River
Mussel Fork	No regulation required

X. Value of Storage

The costs of single-purpose dams and reservoirs are used as a basis

for computing the values of municipal and industrial water and water for quality control.

XI. Conclusions

A. Projections to the year 2060 indicate a requirement of 60.0 mgd in the study area for municipal and industrial water use.

B. Projections to the year 2060 indicate municipal and industrial requirements will be 13 cfs from the Chariton River and seven cfs from the East Fork.

C. Surveys of the strip mine areas are needed to calculate requirements for water quality control due to pollution from these areas.

D. Based on effluents from sewage plants discharging to the streams in the study area, the following minimum flows will be required for water quality control:

Chariton River	33 cfs
East Fork	<u>7 cfs</u>
Middle Fork	3 cfs

E. Streamflow regulation will improve water quality downstream from the reservoirs and will benefit several communities in a large area. Thus, the benefits would be regional and widespread in scope.

F. Values for flows:

Cost of Single-Purpose Reservoir

<u>Year</u> <u>First Needed</u>	<u>CHARITON RIVER</u>	<u>Purpose</u>
1965	\$5,625,000	For water quality control
1980	\$2,210,000	For municipal and industrial water
	<u>EAST FORK</u>	
1965	\$1,800,000	For water quality control
1990	\$1,800,000	For municipal and industrial water
	<u>MIDDLE FORK</u>	
1965	\$1,150,000	For water quality control

cc: Iowa Dept. of Health - Attn: Houser 11/5/62 lrc



